CLAIMS

1. A surface structure for contacting a workpiece, comprising:
a flexible layer adhered to a support element; and
a coating on the flexible layer, said coating having ripples on its surface.

2. A surface structure as defined in claim 1 wherein said flexible layer is thermally conductive.

3. A surface structure as defined in claim 1 wherein said ripples have a pattern.

4. A surface structure as defined in claim 1 wherein said ripples have a localized regular pattern.

5. A surface structure as defined in claim 1 wherein said coating has a workpiece contact surface for contacting the workpiece and wherein said ripples cover substantially the entire workpiece contact surface.

6. A surface structure as defined in claim 1 wherein said ripples comprise elongated, parallel ripples, at least in localized areas of the coating.

7. A surface structure as defined in claim 1 wherein said ripples comprise a multiplicity of microminiature nodules.

8. A surface structure as defined in claim 1 wherein said ripples have wavelengths parallel to said surface that are less than or equal to the mean free path of a gas introduced between the surface structure and the workpiece.

9. A surface structure as defined in claim 1 wherein said ripples have amplitudes perpendicular to said surface that are less than or equal to the mean free path of a gas introduced between the surface structure and the workpiece.

10. A surface structure as defined in claim 1 wherein said ripples have wavelengths parallel to said surface on the order of a few micrometers.

11. A surface structure as defined in claim 1 wherein said flexible layer has a thickness in a range of about 5 to 10 micrometers.

12. A surface structure as defined in claim 1 wherein said flexible layer has a thickness in a range of about 2.5 to 250 micrometers.

13. A surface structure as defined in claim 1 wherein said flexible layer has a thickness in a range of about 7.5 to 15 micrometers.

14. A surface structure as defined in claim 1 wherein said flexible layer comprises a polymer layer.

15. A surface structure as defined in claim 1 wherein said flexible layer comprises silicone rubber.

16. A surface structure as defined in claim 1 wherein said flexible layer comprises polydimethylsiloxane.

17. A surface structure as defined in claim 1 wherein said coating has a thickness in a range of about 0.25 to 0.50 micrometers.

18. A surface structure as defined in claim 1 wherein said coating is selected from the group consisting of silicon nitride, silicon carbo-nitride and carbon.

19. A surface structure as defined in claim 1 wherein said coating comprises silicon dioxide.

20. A surface structure as defined in claim 1 wherein said coating is configured for contacting a semiconductor wafer.

21. A surface structure as defined in claim 1 wherein said flexible layer is configured for absorbing vibrations of the support element.

22. A surface structure as defined in claim 1 wherein said coating comprises a chemically inert, low friction material selected to limit particle generation.

23. A surface structure as defined in claim 1 wherein said ripples are rounded at areas of contact with the workpiece.

24. A surface structure as defined in claim 1 further comprising a film on said coating that is selected for compatibility with the workpiece.

25. A surface structure as defined in claim 1 further comprising an adhesive interface layer for adhering said flexible layer to the support element.

26. A method for making a surface structure, comprising the steps of:
forming a flexible layer;
expanding the flexible layer;
applying a coating to the expanded flexible layer; and
contracting the flexible layer to form ripples in said coating.

27. A method as defined in claim 26 wherein the step of expanding the flexible layer comprises heating the flexible layer and wherein the step of contracting the flexible layer comprises cooling the flexible layer.

28. A method as defined in claim 26 wherein the step of forming a flexible layer comprises forming the flexible layer on a support element.

29. A method as defined in claim 28 wherein the step of forming the flexible layer comprises spraying silicone rubber onto the support element.

30. A method as defined in claim 28 wherein the step of forming the flexible layer comprises spinning silicone rubber onto the support element.

31. A method as defined in claim 26 wherein the step of applying a coating to the flexible layer comprises depositing the coating onto the flexible layer.

32. A method as defined in claim 31 wherein the step of depositing the coating on the flexible layer produces heating and consequent expansion of the flexible layer.

33. A method as defined in claim 26 wherein the step of applying a coating to the flexible layer comprises producing a reaction between a reactive material and a portion of the flexible layer.

34. A method as defined in claim 33 wherein the step of forming a flexible layer comprises forming a silicone rubber flexible layer and wherein the step of producing a reaction comprises reacting the silicone rubber with oxygen to form a silicon dioxide coating.

35. A method as defined in claim 26 wherein the step of forming a flexible layer comprises forming an adhesive interface layer on a support element and applying the flexible layer to the adhesive interface layer.

36. A method as defined in claim 26 further comprising the step of applying to the coating a film that is selected for compatibility with a workpiece that contacts the surface structure in use.

37. A method as defined in claim 36 wherein the steps of expanding and contracting the flexible layer are performed mechanically.

38. Apparatus for cooling a workpiece in a vacuum processing system, comprising:

a workpiece support element;

a surface structure for contacting the workpiece, said surface structure comprising a resilient layer adhered to the support element and a coating on the resilient layer, said coating having ripples on its surface;

a device for pressing the workpiece against the surface structure; and

a cooling gas system for introducing a gas at a selected pressure between said coating and the workpiece.

39. Apparatus as defined in claim 38 wherein the ripples on said coating have a localized regular pattern and substantially cover the portion of the surface structure that contacts the workpiece.

40. Apparatus as defined in claim 38 wherein said ripples comprise elongated, parallel ripples in localized areas of the coating.

41. Apparatus as defined in claim 38 wherein said ripples comprise microminiature nodules.

42. Apparatus as defined in claim 38 wherein said ripples have wavelengths parallel to said surface that are less than or equal to the mean free path of the gas at said selected pressure.

43. Apparatus as defined in claim 38 wherein said ripples have amplitudes perpendicular to said surface that are equal to or less than the mean free path of the gas at said selected pressure.

44. Apparatus as defined in claim 38 wherein said ripples are rounded at areas of contact with the workpiece.

45. Apparatus as defined in claim 38 wherein said ripples have wavelengths parallel to said surface on the order of a few micrometers.

46. Apparatus as defined in claim 38 wherein said resilient layer has a thickness in a range of about 5 to 10 micrometers.

47. Apparatus as defined in claim 38 wherein said resilient layer has a thickness in a range of about 2.5 to 250 micrometers.

48. Apparatus as defined in claim 38 wherein said resilient layer has a thickness in a range of about 7.5 to 15 micrometers.

49. Apparatus as defined in claim 38 wherein said resilient layer comprises a polymer layer.

50. Apparatus as defined in claim 38 wherein said resilient layer comprises silicone rubber.

51. Apparatus as defined in claim 38 wherein said coating has a thickness in a range of about 0.25 to 0.50 micrometers.

52. Apparatus as defined in claim 38 wherein said coating is selected from a group consisting of silicon nitride, silicon carbo-nitride and carbon.

53. Apparatus as defined in claim 38 wherein said coating comprises silicon dioxide.

54. Apparatus as defined in claim 38 wherein said surface structure is configured for contacting a semiconductor wafer.

55. Apparatus as defined in claim 38 wherein said surface structure further comprises a film on said coating that is selected for compatibility with the workpiece.

56. Apparatus as defined in claim 38 wherein said surface structure further comprises an adhesive interface layer between the resilient layer and the support element.

57. Apparatus for electrostatic clamping of a workpiece, comprising:

a platen assembly defining an electrically insulating clamping surface for receiving a workpiece, the platen assembly comprising electrodes underlying and electrically isolated from said clamping surface, a dielectric layer between the electrodes and the clamping surface, and a surface structure defining the clamping surface, said surface structure comprising a resilient layer adhered to said dielectric layer and a coating on the resilient layer, said coating having ripples on its surface; and

a clamping control circuit for applying clamping voltages to the electrodes for electrostatically clamping the workpiece in a fixed position on the clamping surface.

58. Apparatus as defined in claim 57 wherein said resilient layer is thermally conductive.

59. Apparatus as defined in claim 57 wherein said ripples form a regular pattern, at least in localized areas of the surface, and wherein said ripples cover substantially the entire area of said clamping surface.

60. Apparatus as defined in claim 57 further comprising a cooling gas system for introducing a gas at a selected pressure between said coating and the workpiece.

61. Apparatus as defined in claim 60 wherein said ripples have wavelengths parallel to said surface that are less than or equal to the mean free path of the cooling gas at said selected pressure.

62. Apparatus as defined in claim 60 wherein said ripples have amplitudes perpendicular to said surface that are less than or equal to the mean free path of the cooling gas at said selected pressure.

63. Apparatus as defined in claim 57 wherein said resilient layer has a thickness in a range of about 5 to 10 micrometers.

64. Apparatus as defined in claim 57 wherein said resilient layer comprises silicone rubber.

65. Apparatus as defined in claim 57 wherein said coating has a thickness in a range of about 0.25 to 0.50 micrometers.

66. Apparatus as defined in claim 57 wherein said coating is selected from the group consisting of silicon nitride, silicon carbo-nitride and carbon.

67. Apparatus as defined in claim 57 wherein said coating comprises silicon dioxide.

68. Apparatus as defined in claim 57 wherein said platen assembly is configured for clamping a semiconductor wafer.

69. Apparatus as defined in claim 57 wherein said resilient layer has a thickness in a range of about 2.5 to 250 micrometers.

70. Apparatus as defined in claim 57 wherein said resilient layer has a thickness in a range of about 7.5 to 15 micrometers.

71. Apparatus as defined in claim 57 wherein said resilient layer comprises a polymer layer.

72. Apparatus as defined in claim 57 wherein said surface structure further comprises a film on said coating that is selected for compatibility with the workpiece.

73. Apparatus as defined in claim 57 wherein said surface structure further comprises an adhesive interface layer between said resilient layer and said dielectric layer.